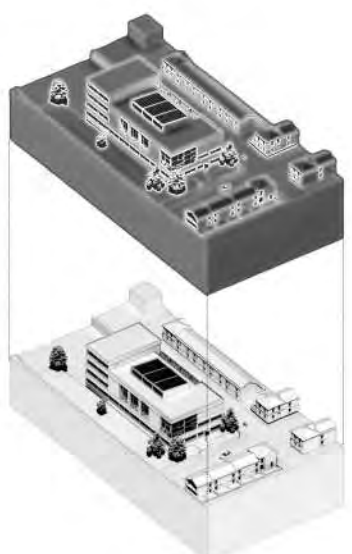
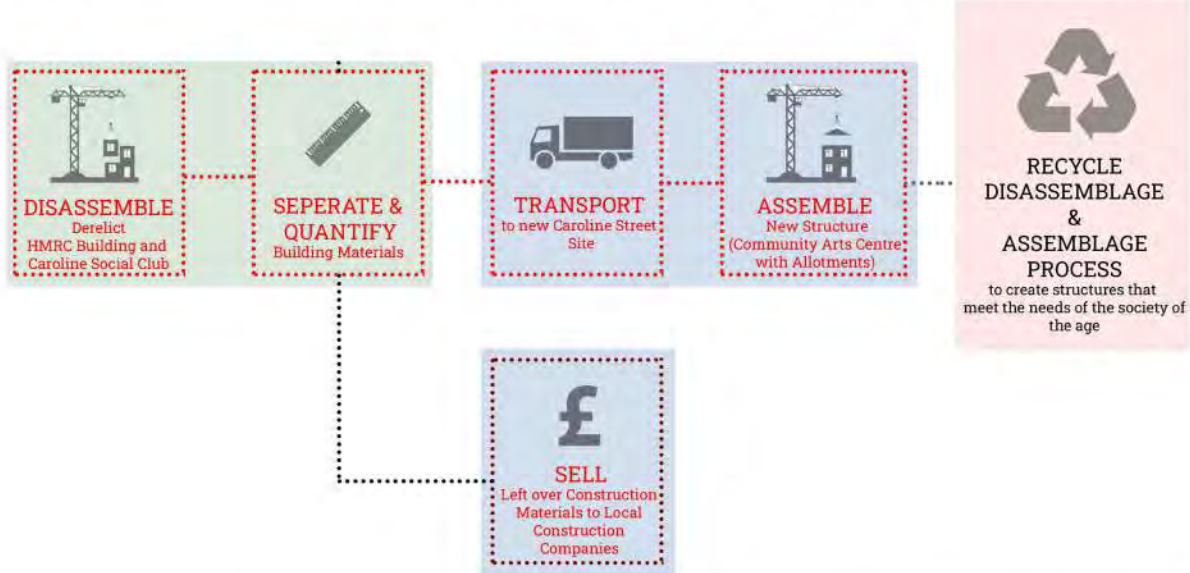


**CIRCULAR CONCRETE - A SUSTAINABLE TOOL**

By adopting a circular economy approach in construction, the life cycle and span of construction materials are extended. This results in less waste and a reduction in the amounts of materials to be manufactured. The benefits are plentiful regarding the environment. Discarded materials from buildings that are to be demolished can be reused in other building projects. Sometimes the materials may be used for the same application whereas other times they may be used in a differing way. In order for materials to be reused the building to be demolished needs to be dismantled carefully. The materials will then be documented for reuse. This creates a circular as opposed to linear flow of material supply chain. Please see Figure (18). This approach to construction has historically been used for centuries, however has declined in recent decades due to the increase in cheap mass production and rules and regulations set by the government. It had been common practice for 'building blocks of old structures to be typically used to form new ones, and old materials repurposed until no longer fit for use' (Hobbs et al, 2021). In more recent times, material reuse attracts an exclusive market which is often for high-end reclamation catering for a certain desirable 'heritage' aesthetic' (Williams, 2022). The use of digital twin technology could have the potential to broaden the market for material reuse to environmentally beneficial society as a whole. From small scale to commercial projects the circular economy method could be implemented as a driver for climate resilience and not just a slightly pretentious aesthetic for the more affluent members of society.

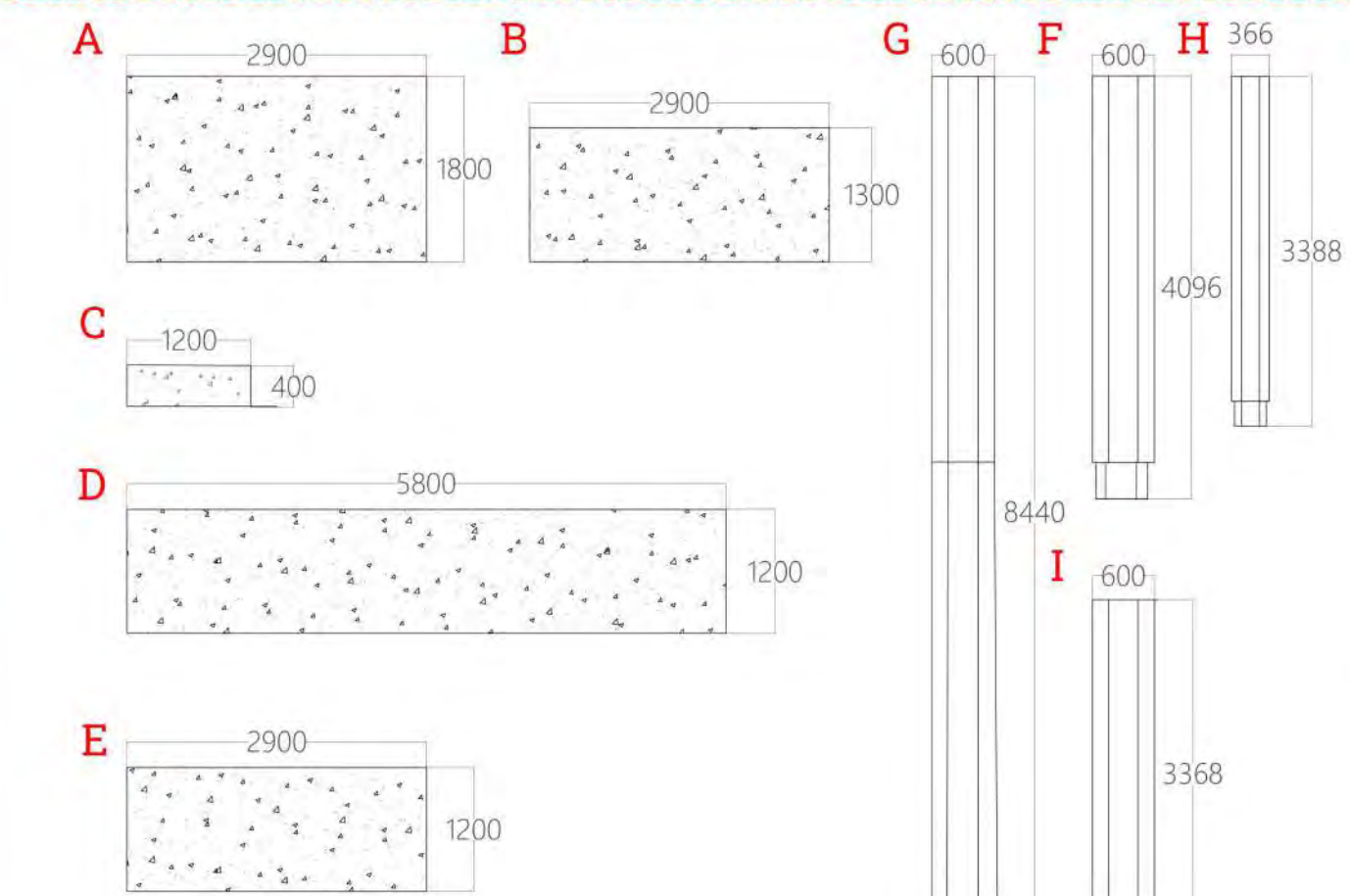
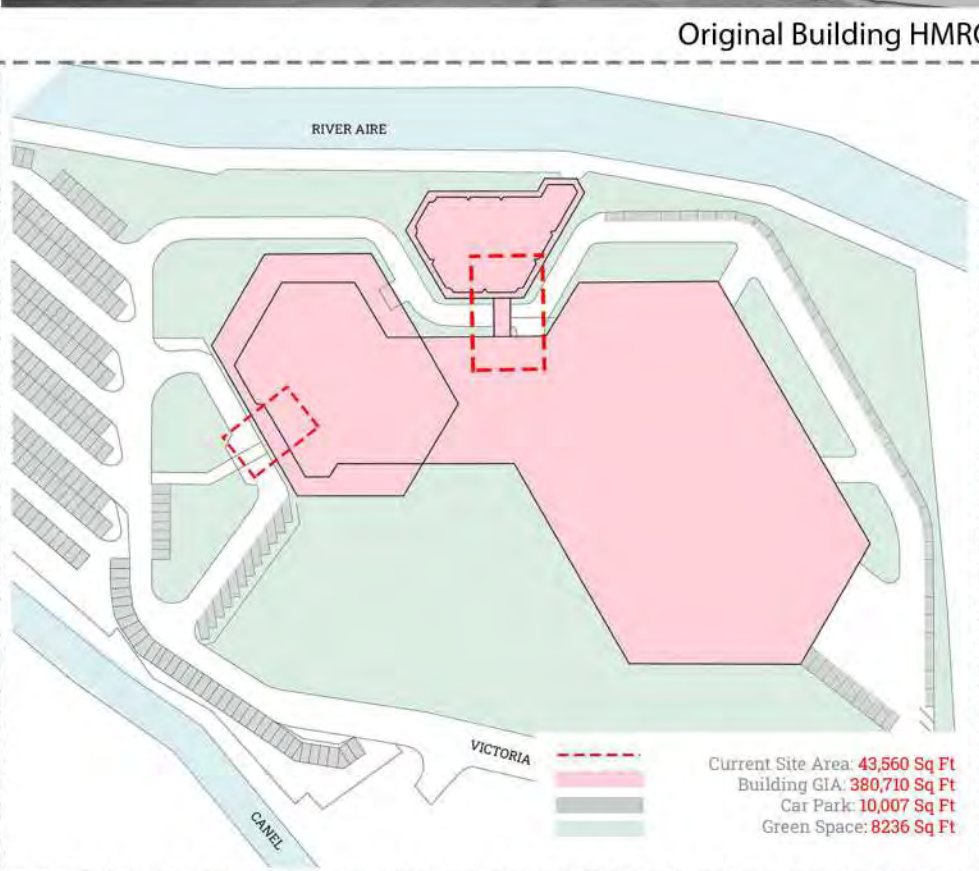
The project proposes a Cultural Centre situated in the UNSECO world heritage site of Saltire. The building will have the ability to adapt over time due to its modular approach. The current building shall serve its purpose as a theatre and indoor market. An investigation as to how building components can be re-used to eliminate linear material (concrete) flows shall be interrogated. Pre-Cast concrete elements shall be taken from the soon to be demolished 'HMRC' building in Saltire. The elements shall be used to build the local cultural centre. Concrete elements shall be directly re-used, used to act as a new component due to materiality properties and will be used in completely new applications. Concrete is not commonly reused at present due to lack of material information. Contractors do not want to buy unsatisfactory components due to high risk. If a digital twin is built alongside future and present concrete buildings lack of building information will not exist as material history and data will be documented.



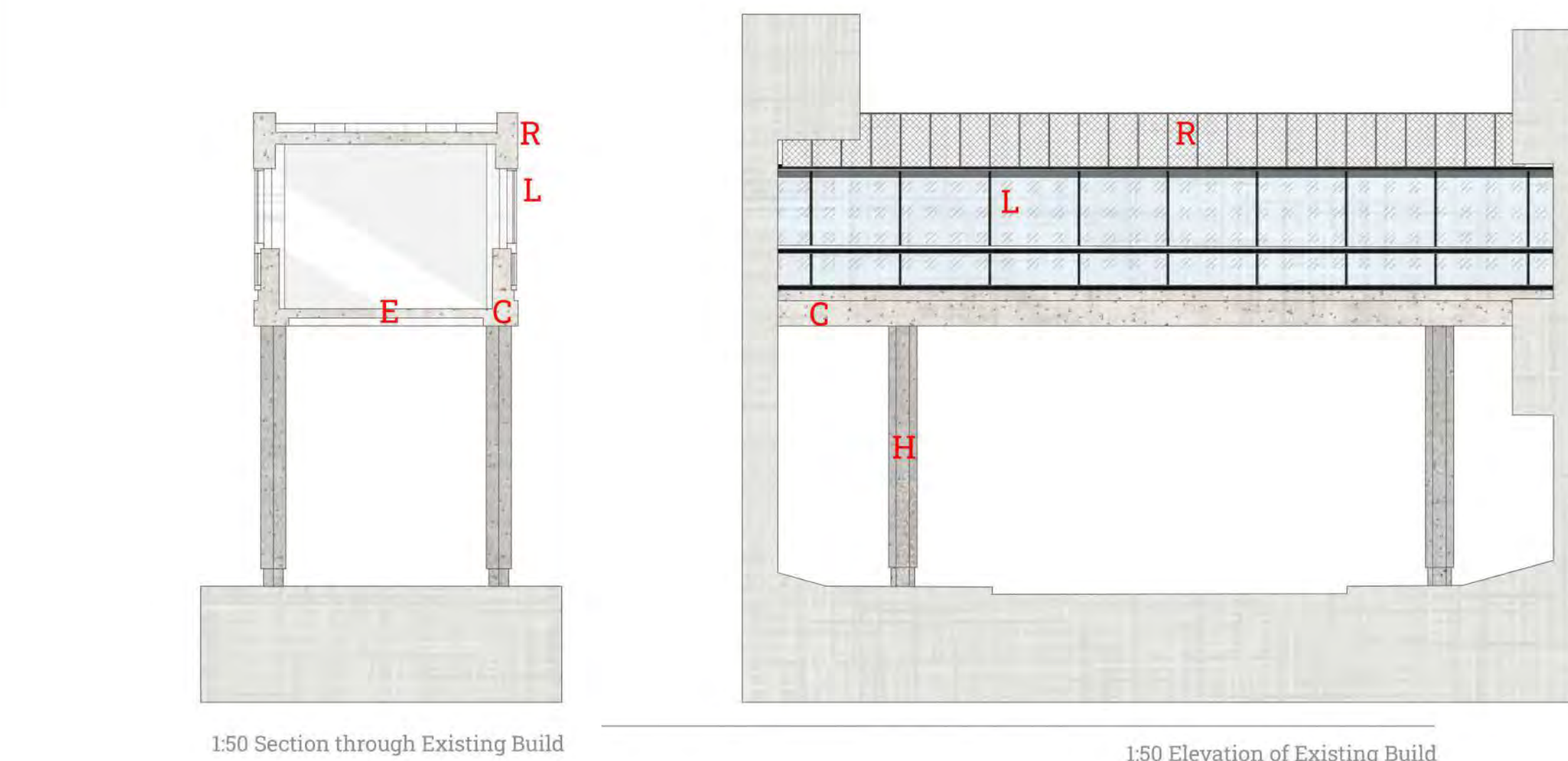
Future Proof Digital Twin Technology



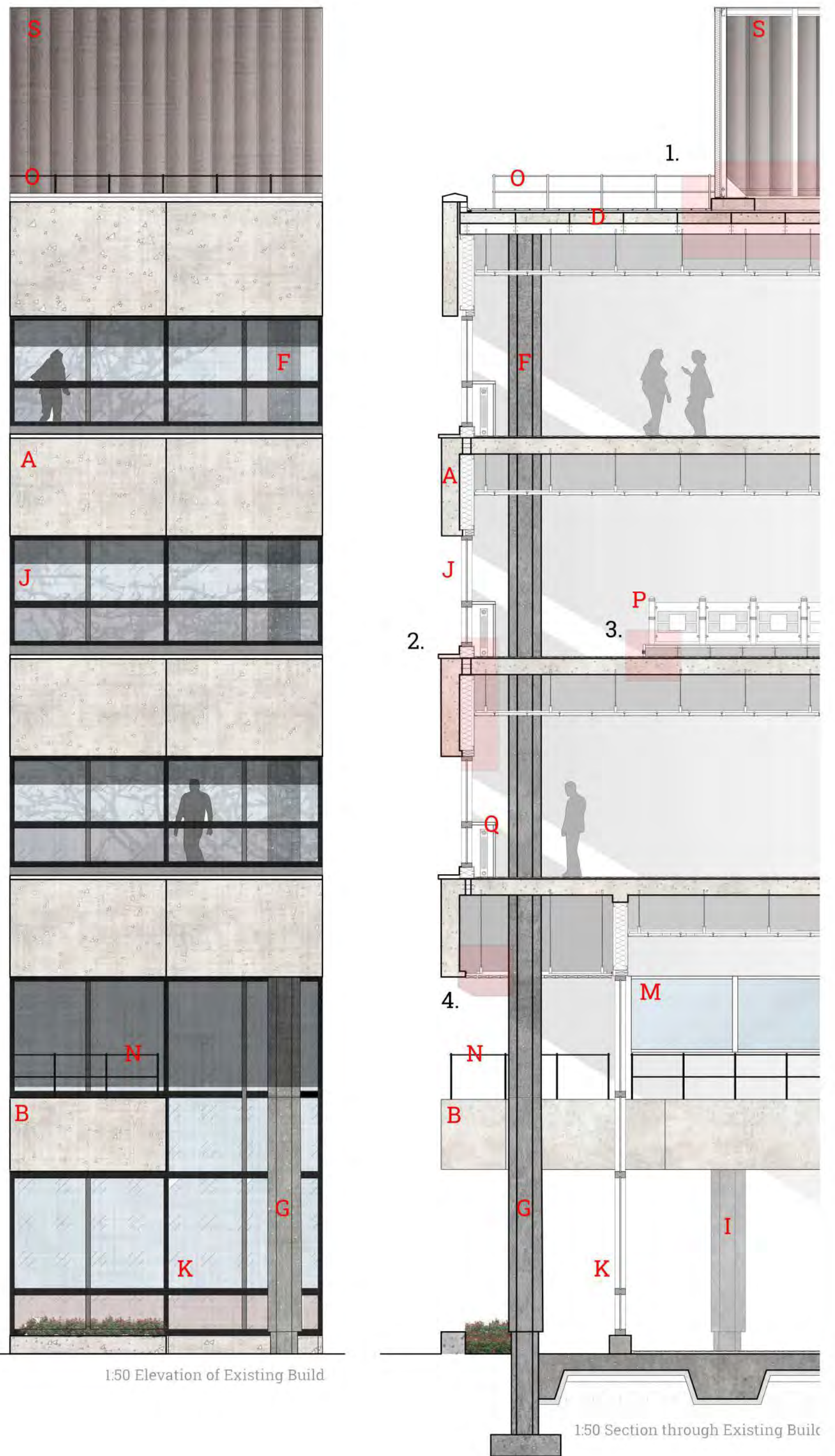
BUILDING CODE	Component Identity	Dimensions (mm)	Quantity	Weight (kg)	Weight (Tonnes)
A	Pre-Cast Concrete Façade Panels	2900x1800x200	516	80054	40
B	Pre-Cast Concrete Façade Panels	2900x1300x200	48	57817	58
C	Pre-Cast Concrete Façade Panels	1200x400x200	N/A	N/A	N/A
D	Pre-Cast Concrete Floor Panels	5800x1200x200	N/A	N/A	N/A
E	Pre-Cast Concrete Floor Panels	2900x1200x200	N/A	N/A	N/A
F	Concrete Columns - Steel Reinforced	4096x600	N/A	N/A	N/A
G	Concrete Columns - Steel Reinforced	8940x600	N/A	N/A	N/A
H	Concrete Columns - Steel Reinforced	3388x366	N/A	N/A	N/A
I	Concrete Columns - Steel Reinforced	3368x600	N/A	N/A	N/A



Original Building Components  
Approximation from Revit Model and GOV Planning Documents  
Full building survey would have to be completed for accuracy \*dims will vary\*



**PHASE 1 - Disassemble/ Seperate & Quantify**



**PHASE 2 - Transport**

Road Transport  
0.10650 (gCO2e/kg/km) - Emission Factor



**D - Pre-Cast Façade Panels**

Embodied Carbon of Glazing:  
Density (kg/m³) x Volume (m³) = Mass (tonnes) = 58t

A1 - Embodied Carbon Production  
58t x 2.4 = 26.68tCO<sub>2</sub>e  
(2.4 = (kgCO<sub>2</sub>e/kg) - Prefabricated Concrete - Embodied Carbon per tCO<sub>2</sub>e of material)

**Importing Glazing from Global Source**

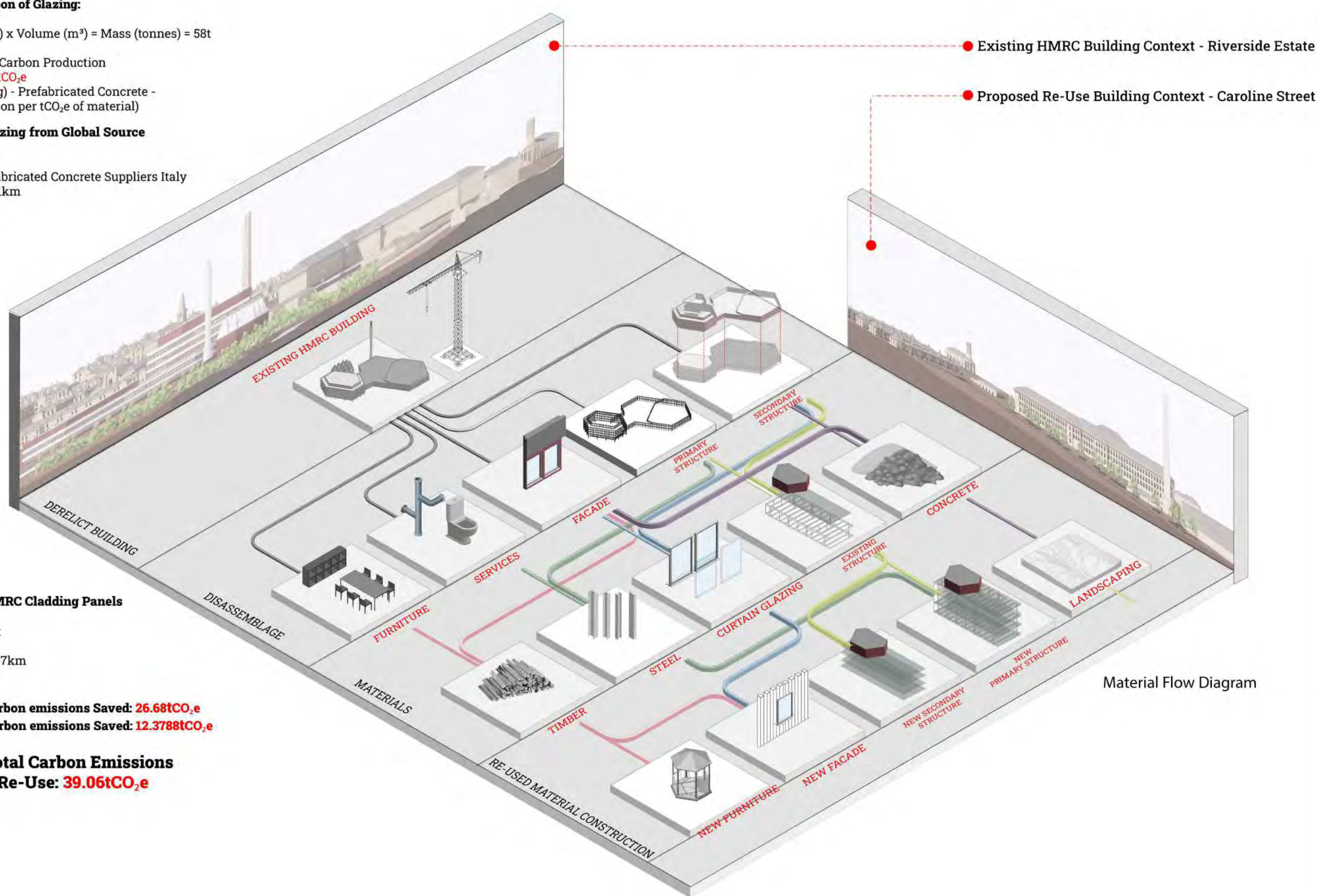
A2 - Transport  
Baraciti - Prefabricated Concrete Suppliers Italy  
Distance - 2001km  
= 12.38tCO<sub>2</sub>e

**Re-Use of HMRC Cladding Panels**

A2 - Transport  
Saltire  
Distance - 3397km  
= 0.0012tCO<sub>2</sub>e

Embodied Carbon emissions Saved: 26.68tCO<sub>2</sub>e  
Transport Carbon emissions Saved: 12.378tCO<sub>2</sub>e

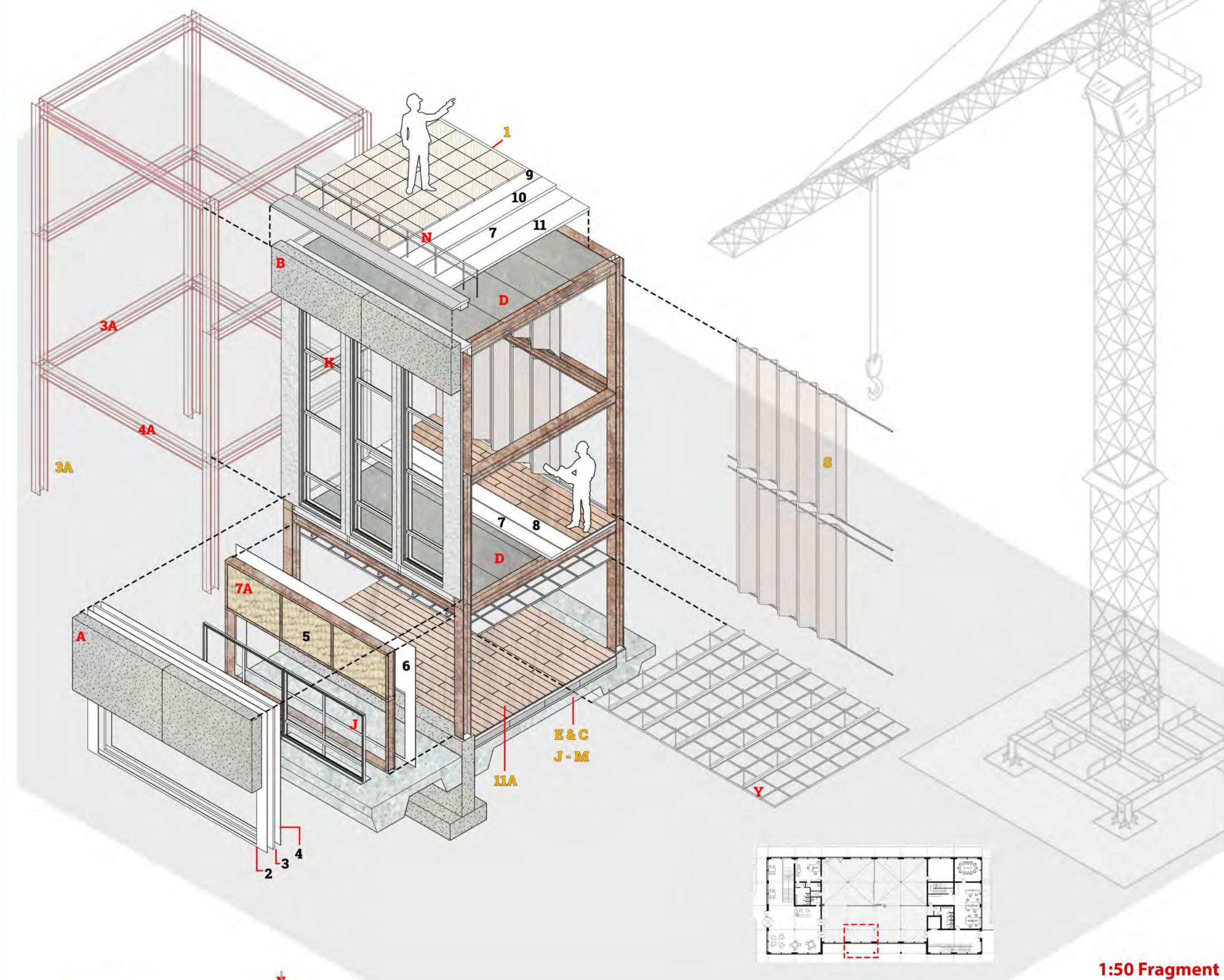
Overall Total Carbon Emissions Saved by Re-Use: 39.06tCO<sub>2</sub>e



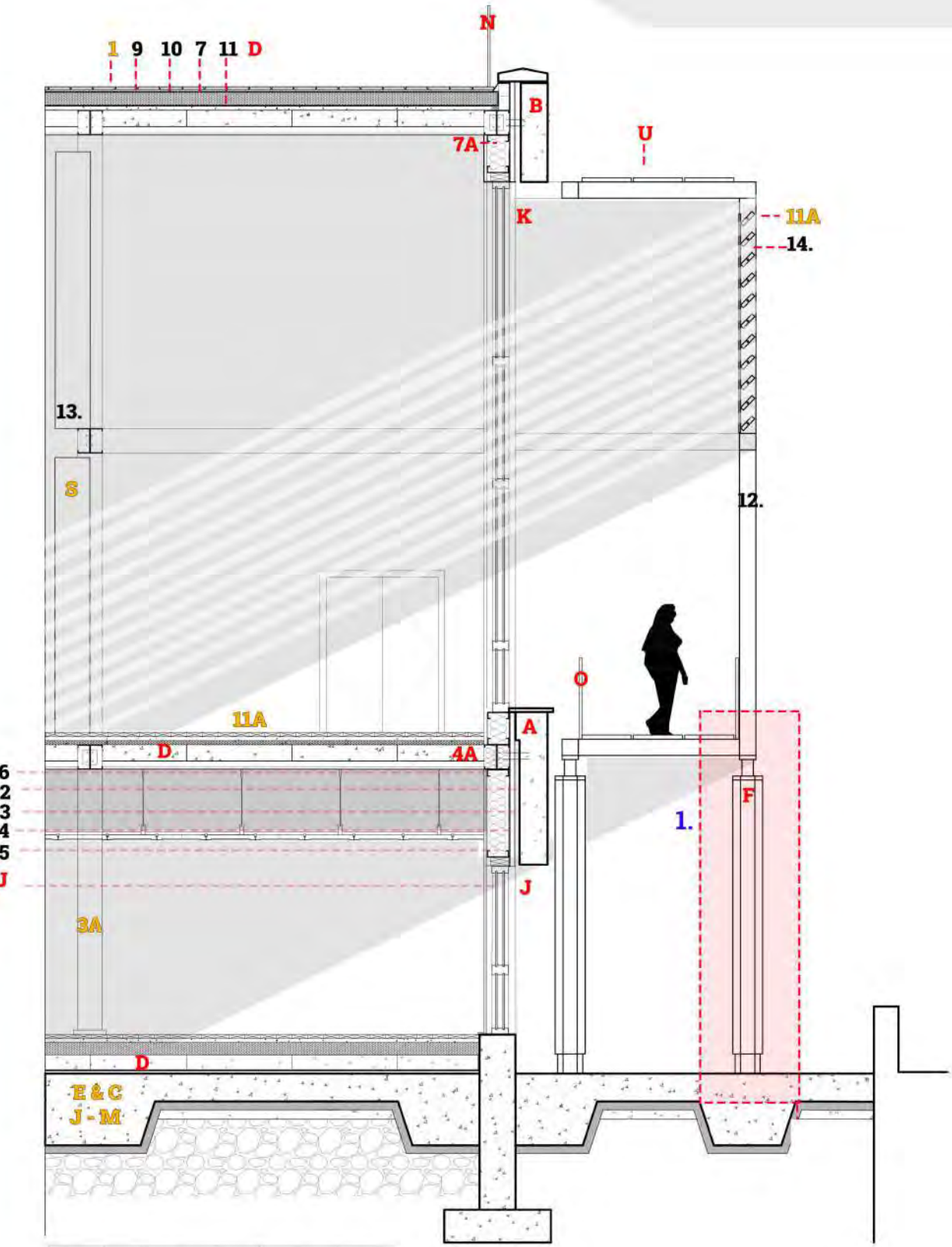


**CIRCULAR CONCRETE - A SUSTAINABLE TOOL**

**PHASE 2 ASSEMBLE**

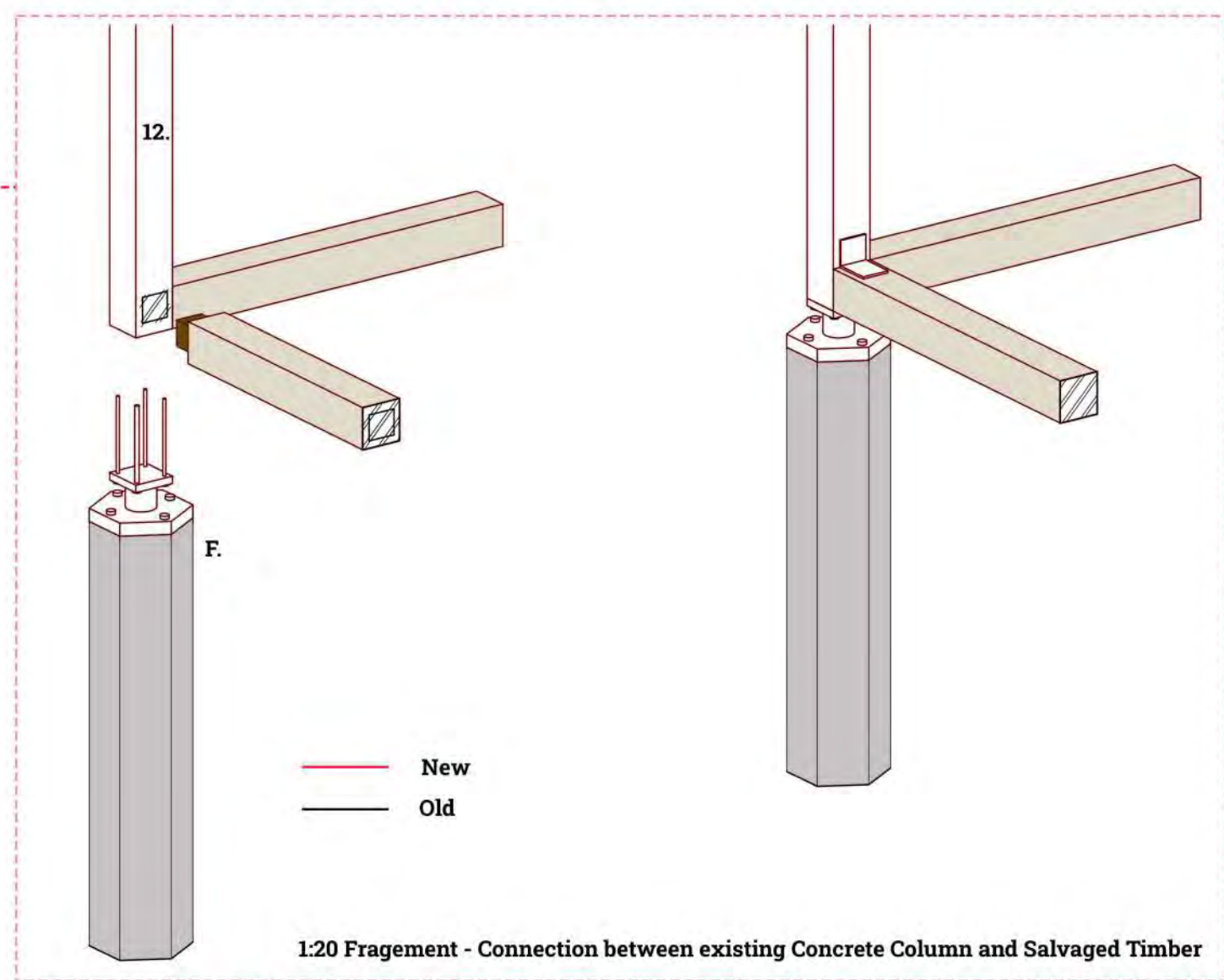


1:50 Fragment



1:50 Section Fragment

**A New Method of Assembly - Making use of Old Precast Concrete**



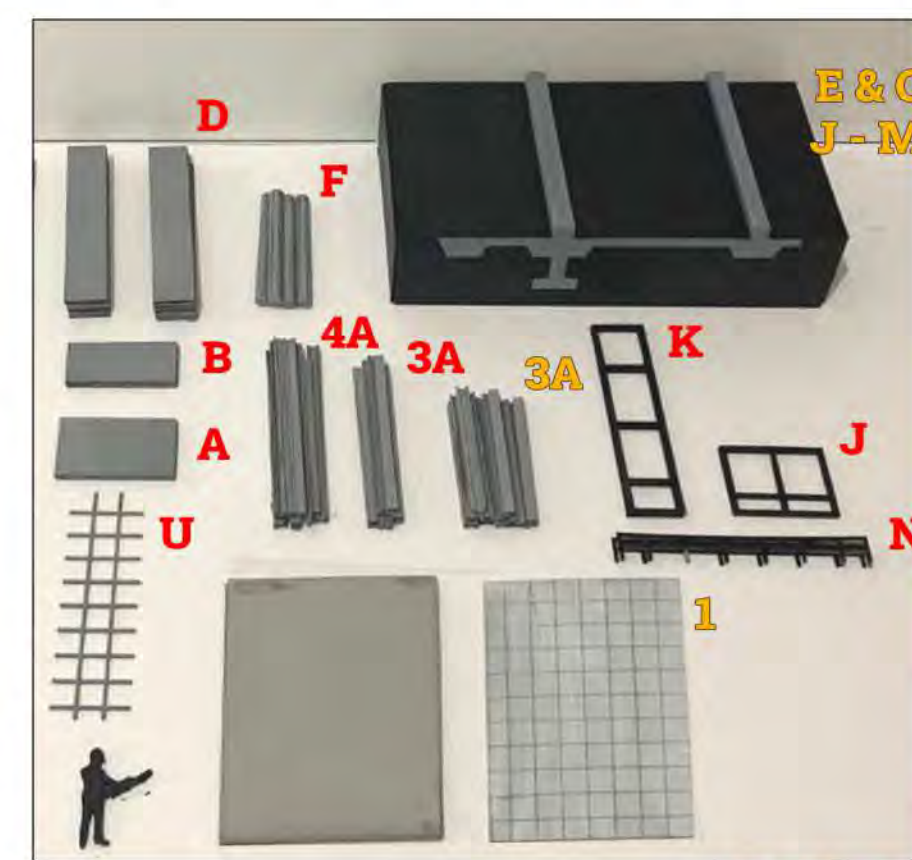
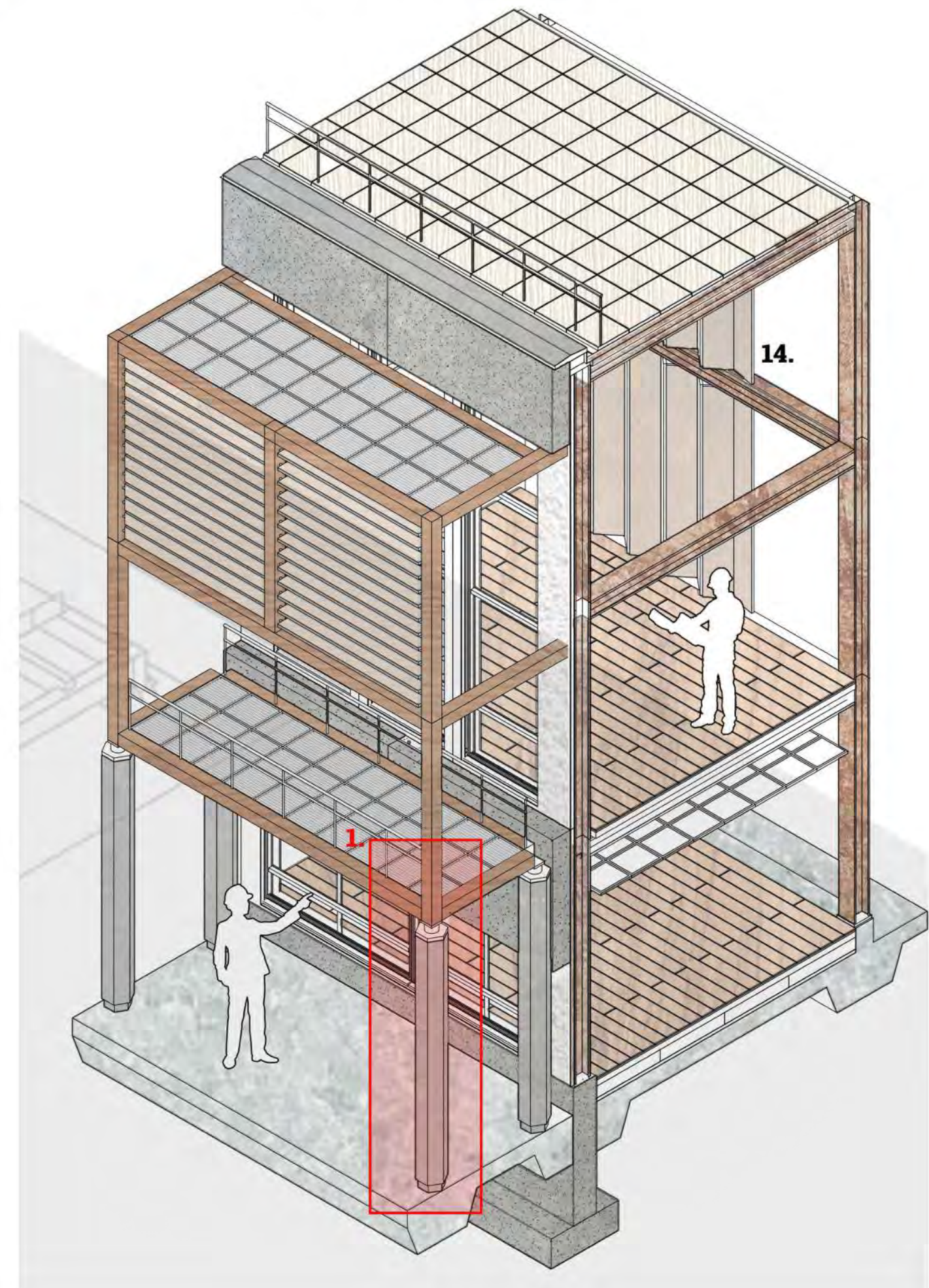
1:20 Fragment - Connection between existing Concrete Column and Salvaged Timber

**Reused HMRC Building Components**

BUILDING CODE	Component Identity	Dimensions (mm)
A	Pre-Cast Concrete Façade Panels	2900x1800x200
B	Pre-Cast Concrete Façade Panels	2900x1300x200
C	Pre-Cast Concrete Façade Panels	1200x400x200
D	Pre-Cast Concrete Floor Panels	5800x1200x200
E	Pre-Cast Concrete Floor Panels	2900x1200x200
F	Concrete Columns - Steel Reinforced	400x600
G	Concrete Columns - Steel Reinforced	884x600
H	Concrete Columns - Steel Reinforced	338x366
I	Concrete Columns - Steel Reinforced	336x600
J	Curtain Glazing	2940x2025
K	Curtain Glazing	1490x664
L	Curtain Glazing	2380x1560
M	Curtain Glazing	2380x1410
N	Rail	659x850
O	Rail	1000x50
P	Rail	940x84
Q	Radiator	1197x880
R	Anodised Aluminium Panel	760x690
S	Acoustic Panel Board	3340x425
T	Suspended Floor Frame	600x360
U	Aluminium Access Floor Grille	600x600
V	Acoustic Suspended Ceiling	600x600
W	Steel Base Plate	500x300
X	Steel Base Plate	500x300
Y	Suspended Ceiling Frame	1200x800
Z	Timber Suspended Ceiling	600x600
1A	Suspended Ceiling Frame	950x1550
2A	Timber Panel Acoustic	2400x600
3A	I-BEAM	300x300x5x100
4A	I-BEAM	300x300x5x100
5A	I-BEAM	102x178x5x240
6A	I-BEAM	102x178x5x800
7A	Steel C-Column	260x75x5x800
8A	Steel C-Column	145x65x5x240
9A	Square Hollow Section	145x65x5x1200
10A	Square Hollow Section	100x100x2400
11A	Sawn Timber	220x4000x47

**Repurposed Building Components**

- 1 - 600x600 Bathroom Tiles
  - Roof Paving
  - 2A - 300x300-5100 I Beam
  - Cut to 4000mm
  - 11A - 220mm Sawn Timber
  - Cut to create internal flooring.
  - E&C - Concrete pre-cast panels
  - Crushed to reinforce foundations.
  - J-M - Glass
  - Crushed and mixed into foundations.
  - S - Acoustic Panel
  - Folding separation panels.
- New Materials**
- 2 - Lime Render Board - 25mm
  - 3 - Rigid Insulation Board - 50mm
  - 4 - Breather Membrane - 1mm
  - 5 - Linen offcuts - Locally Sourced Insulation 300mm
  - 6 - Plaster Board - 10mm
- \*All boards shall be offcuts**
- 7 - Rigid Wool Insulation - 150mm
  - 8 - Screed - 40mm
  - 9 - Waterproof Membrane - 4mm
  - 10 - Rigid Insulation - 100mm
  - 11 - Vapor Control Layer - Old Posters
  - 12 - Low e-rance Glazing
  - 13 - Salvaged Timber Frame - 200x200mm
  - 14 - Metal Guide Rails for Acoustic Room Dividers
  - 14 - Tilt Rods



Kit of Parts

